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THE DESCRIPTION and USE OF NAIRNE'S Patent Electrical Machine;

WITH THE ADDITION OF SOME

PHILOSOPHICAL EXPERIMENTS

AND

MEDICAL OBSERVATIONS.

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THE
DESCRIPTION AND USE
OF
NAIRNE's
Patent Electrical Machine.

THOUGH this machine and its apparatus are conſtructed with a particular view to the purpoſes of medicine, yet it will be found equally applicable to philoſophical uſes. All its parts are inſulated in the beſt poſſible manner, and from the expence and ſtudy which the inventor has beſtowed in rendering it perfect, it is much ſuperior in its action to any machine of the ſize yet made. In the following deſcription the ſame letter of the alphabet is uſed to denote the ſame thing in all the engravings, and every attention has been paid to make the whole intelligible and clear.

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CHAP. I.

A DESCRIPTION OF THE PARTS OF WHICH THE MACHINE IS COMPOSED.

PLATE I. contains a perſpective view of the machine, all its parts being properly put together. The letters of reference in the preſent chapter reſpect this plate, except where it is otherwiſe mentioned.

A. The glaſs cylinder.

B B. Two glaſs pillars which ſupport the glaſs cylinder A.

C. The handle by which the glaſs cylinder A is turned.

G and R. Two metallic conductors.

D D. Two glaſs pillars, one ſupporting the conductor R, and the other G.

E. The board into which the pillars B B, which ſupport the cylinder A are fixed.

Underneath this board are faſtened pieces of wood forming four grooves.

F F. Two pieces of wood, part of which are inſerted into two of the grooves under the board E. In theſe pieces are fixed the pillars D D, which ſupport the conductors R and G.

H H. Two knobs of braſs ſoldered on the outſide of each of the conductors G and R.

I. The cuſhion which is attached by a contrivance hereafter mentioned, to the ſide of the conductor R, between that and the cylinder A. The end of it is ſeen at Plate III. Fig. 1, 2, and 6.

K. The ſilk, one end of which is glued to the under part of the cuſhion I. It is turned over upon the cylinder A, ſo that part of the ſilk is between the cylinder A and the cuſhion I.

L L. Are ſcrews of wood which paſs through from the upper part of the board E, and are to be ſcrewed till the lower ends preſs againſt the upper part of the ſliding pieces F F, when ſlipped into the grooves under the ſaid board. The uſe of one is to keep the cuſhion I in its place when preſſed gently againſt the cylinder A, and the other is intended to keep the conductor G ſteady.

M. The points which are ſoldered to that ſide of the conductor G which is next the cylinder A. They are only ſeen at Plate III. Fig. 2.

N N. The ends of the conductors G and R, which may be taken off from the other part, as repreſented Plate V. Fig. 1, 2.

S. An electrical coated glaſs jar faſtened in the inſide of the conductor G. In the inſide of this jar is fitted a piece of cork, and in the cork a ſmall glaſs tube coated, and likewiſe a braſs wire with a ball, which are ſeen Plate V. Fig. 1, 2.

The internal part of the conductor R is fitted up exactly in the ſame manner.

P P. Are knobs of braſs ſcrewed faſt to the board E. A piece of tin-foil is paſted on the board, ſo as to make a metallic communication between them. This piece of tin-foil, which is repreſented by the two parallel lines in Plate I. Plate IV. Fig. 1. and Plate V. Fig. 1. is not very viſible in the real machine, being blacked over like the board E.

O, The electrical ſtool, with its four glaſs legs. On the top of the board of the ſtool is faſtened a piece of lead communicating with two holes, into either of which holes the end of one of the tubes with the pliable joints f f f Plate II. are to be put, the other end being connected with either of the conductors. See Plate IV. Fig. 1 and 3.

Q. A large ſheet of paper to place the glaſs legs of the ſtool on. It is uſed to prevent the duſt or lint flying up from the floor or carpet to the ſtool when electrified. See Plate IV. Fig. 1, 3.

CHAP. II.

A DESCRIPTION OF THE APPARATUS.

PLATE II. contains drawings of the apparatus not deſcribed in the preceding chapter. In this plate the parts are repreſented as detached from the machine; but the plates referred to, are thoſe in which their application is ſhewn.

a An iron clamp, or vice, Plate IV. Fig. 1.

b An iron chain, with a braſs ring at each end, Plate I. Plate III. Fig. 1. Plate IV. Fig. 1. and Plate V. Fig. 1, 2.

c A piece of card-paper, with a round piece of leather glued to it, on which the amalgam is firſt ſpread, before it is applied to the glaſs cylinder A.

d A compound joint, which has not only a vertical, but alſo an horizontal motion, when applied to the conductor G or

R,

R, Plate III. Fig. 1, 2. 5, 6. Plate IV. Fig. 1, 2.

e e e Three metallic tubes, connected by means of two wooden joints; they are here repreſented as ſcrewed to d, Plate III. Fig. 1, 2, 3, 4.

f f f Three metallic tubes, connected by means of four pieces of wood, and two pliable or flexible joints, Plate I. Plate III. Fig. 5 and 6. Plate IV. Fig. 1, 2, 3.

g A piece of wood fixed to one of the tubes f, and which has a hole at right angles to the tube, Plate I. Plate III. Fig. 5 and 6. and Plate IV. Fig. 1, 2, 3.

h A metallic ball, ſcrewed to the end of one of the tubes f or e, Plate I. Plate III. Fig. 1, 2, 5, 6. Plate IV. Fig. 2 and 3.

i Braſs or wooden conical points, Plate III. Fig. 3, 4.

k Glaſs handle, Plate III. Fig. 5 and 6. Plate IV. Fig. 3. Plate V. Fig. 2.

l Clamp or vice of wood, Plate IV. Fig. 2.

m Metallic cord, covered with worſted, Plate IV. Fig. 2 and 3.

n Electrometer, Plate V. Fig. 1 and 2.

o Braſs chain, with a ring at one end, and at the other a piece of braſs wire, Plate V. Fig. 1, 2.

p Piece of wood, with the braſs wire of o fixed to it, and which has a hole at right angles to the wire, Plate V. Fig. 1 and 2.

q Screw driver for tightening the ſide joint of d.

r Forked ſcrew driver for tightening the vertical joint of d, and alſo the two joints of e.

s Pointril, to be put into the ſmall hole at the end of one of the tubes e or f, to unſcrew them, in caſe they ſhould get too tight to be unſcrewed by hand from the joint d.

t The luminous inſulated diſcharging rod.

With each electrical machine, which has the compleat medical apparatus, there are ſent two ſets of that part of the apparatus marked b, c, d, eee, fff, i, k, op; and alſo ſix balls of three different ſizes, viz. two of each ſize. And likewiſe two coated electrical jars, and two coated glaſs tubes, viz. one of each fixed in each conductor It muſt be obſerved, that the tubes eee unſcrew only from the joint d; no attempts ſhould be made to unſcrew any other part, except the balls or points that may occaſionally be ſcrewed on at the other end: the ſame likewiſe muſt be obſerved of the tubes fff, excepting that the tube to which g is fixed, may be unſcrewed out of the piece of wood which connects it to the flexible joint.

CHAP. III.

DIRECTIONS FOR PUTTING THE PARTS OF THE MACHINE PROPERLY TOGETHER, AND PREPARING IT FOR USE.

1. HAVING lifted the machine out of the box by taking hold of the wood work of the glaſs cylinder A, ſet it upon a table, as repreſented Plate I. on which it is to be uſed, and faſten it there by means of the clamp a.

2. The glaſs pillars D D which ſupport the conductors G and R, are fixed to two ſliding pieces F F; theſe; for the conveniency of packing the machine in a ſhorter box, are ſlipped into two grooves under the board E, which are near the end at which the name is ſtamped. The handle C is alſo reverſed for the ſame reaſon. Theſe pieces F F with the glaſs pillars and conductors are to be drawn out of the grooves under the board E, and ſlipped

into the two other grooves, [redacted]. The handle muſt likewiſe be properly fixed, and the machine will then appear as in Plate I.

3. Take a clean, dry, ſoft linen cloth not very old, as they are apt to have the lint come off, and wipe every part till it be perfectly free from duſt or moiſture, particularly the glaſs cylinder A, and the pillars B B and D D. If the air be moiſt they ſhould be wiped with a dry warm linen cloth, an old ſilk handkerchief, or any other piece of ſilk. This ſhould be done every time the machine is uſed, and likewiſe while it is uſing, if worked for any length of time. In very damp weather it will be proper to dry the whole machine gently, except the cuſhion, by placing it at a diſtance before the fire; but this will be very ſeldom neceſſary. The cuſhion I, with its ſilk K, muſt alſo be wiped clean from duſt, and any amalgam which may looſely adhere to them muſt alſo be wiped off.

4. On the wood of the cuſhion are fixed two braſs ſcrews, the heads of which are to be ſlipped in between the ſlits in two pieces of braſs that are ſoldered to the conductor R; then lay the ſilk K ſmooth on the cylinder A, and part of it will be between the leather of the cuſhion and the cylinder.

5. Now gently preſs the cuſhion with the ſilk againſt the glaſs cylinder A, by moving the ſlider F further under the board E, and fixing it there by the ſcrew L.

It is proper to mention, that the ſcrews L L muſt not be ſcrewed down very hard, as in that caſe they might force off the wooden pieces which form the grooves under the board E in which the ſliders F F move.

6. Hang one of the rings of the chain b on the braſs knob H of the conductor R, the other end reſting on the table.

7. Turn the ſilk from the glaſs cylinder A back on the conductor R.

8. The machine being prepared according to the foregoing directions, take one of the pieces of card C with the leather glued on it, on which ſome amalgam is ſpread; rub the amalgamed part of the leather on the glaſs cylinder A, about ten or twelve times backwards and forwards in the direction of its length, on that part which is near the cuſhion; at the ſame time gently turning the handle, ſo that the upper part of the cylinder may paſs from the cuſhion towards G, the oppoſite conductor. This is to be underſtood in all caſes where the cylinder is directed to be turned.

9. The cylinder A being now ready to be excited, replace the ſilk as directed § 4. and turn the cylinder A. Then apply, at about an inch or two from the conductor G, a ball h at the end of one of the tubes f, and ſtrong ſparks will be received on it, ſee Plate I. If every thing be dry and in order, the machine will be found greatly to exceed any electrical machine of the ſame ſize yet made.

10. This method of applying the amalgam muſt be repeatedly uſed whenever the electricity becomes weak, but no amalgam muſt be put on the rubbing part of the ſilk, except what it obtains from the amalgamed piece of leather, while the cylinder A is rubbed with it.

11. By often rubbing the amalgamed part of the leather againſt the cylinder A, the ſurface of the amalgam will become ſmooth and dry; ſo that after having been uſed ſome time, the glaſs cylinder A will not be excited ſtrongly when rubbed with it. In this caſe a ſmall quantity of freſh amalgam, not more than the ſize of half a pea, muſt be taken out of the box marked AMALGAM, and ſpread on the leather, and applied as before; by which means the cylinder may always be excited very ſtrongly, and the quantity of amalgam in the box will laſt for a long time.

12. The ſtrength of the ſpark is regulated by means of the different ſized balls, that is to ſay, if very ſtrong ſparks are required,

the largeſt ball muſt be uſed, if weaker the next ſmaller ones, and if very weak the metallic points.

13. If the machine be required to produce its greateſt effect, it ſhould be uſed in a dry warm room; for it is a fact well known to electricians, that if the air be moiſt, the moiſture will conduct the electricity away almoſt as faſt as it is excited.

14. If the axis and pivot upon which the glaſs cylinder turns ſhould at any time want greaſe, the cylinder may be taken out of its frame by unſcrewing the two ſcrews at the top of the glaſs pillar near the handle, and may be replaced after applying the quantity of greaſe required.

C H A P. IV.

OF THE USE AND APPLICATION OF THE PATENT ELECTRICAL MACHINE TO MEDICAL AND PHILOSOPHICAL PURPOSES.

HAVING deſcribed the electrical machine and apparatus, and alſo given directions for preparing the machine for uſe, it will now be proper to give directions for their application.

1. It is univerſally allowed that the electrical fluid can be rarefied or condenſed.

2. This electrical machine, therefore, may not be improperly called a machine for rarefying or condenſing the electrical fluid.

3. The glaſs cylinder A, by rubbing againſt the ſilk K, that is between the cuſhion I and cylinder A, is continually depriving, not only the cuſhion of its

electricity, but alſo the conductor R, connected with it. This is as conſtantly ſupplied from the earth, or common ſtock, by the chain b, while it hangs from the conductor R to the table. The electricity, thus drawn from the earth up the chain b, to the conductor R, and cuſhion I, is ſuperinduced or condenſed on the conductor G. If now the knuckle be applied within the ſtriking diſtance of the conductor G, then G will give or part with the electricity ſuperinduced or condenſed on it, to the knuckle oppoſed to it.

4. But if the chain b is hung on the knob H of the other conductor, viz. G, then the cylinder, by rubbing againſt the ſilk, exhauſting, as before, the cuſhion I and conductor R, carries the electricity to the conductor G; but in this caſe it is not ſuperinduced or condenſed on it as before, for the chain b hanging from G to the table, which communicates with the earth, conveys it away to the earth, or common ſtock, as faſt as G receives it, ſo that G re-

mains in its natural ſtate, and R is exhauſted more or leſs of its natural quantity of electricity.

Now if the knuckle be brought within the ſtriking diſtance, an electrical ſpark will be received from the knuckle by R, to ſupply what it has been deprived of. And theſe ſparks will be continually received from the knuckle, or any blunt body, brought within the ſtriking diſtance, while the cylinder A is excited ſo as to exhauſt R; for which purpoſe it is always requiſite that the chain b, hanging on G, ſhould make a communication between it and the earth.

5. But if the chain b is not hung either to R or G, neither of them will have any communication with the earth, becauſe the cylinder A, and the conductors R and G, are inſulated by means of the glaſs pillars B B and D D. Then, on turning the cylinder, the electricity will be exhauſted, as before, from I and R, and only that quantity of electricity which is contained

in them, or part of that quantity, will be ſuperinduced on G; and this quantity, as it cannot get off from G to the earth, will be continually paſſing back again under the cylinder A, to that part which was exhauſted of it.

6. Whence it is obvious, that this machine, to uſe the common mode of expreſſion, is either a negative, or poſitive one, and may inſtantly be changed from the one to the other.

7. It may alſo be made immediately to act on a perſon in the ſame manner as if he was electrified by two diſtinct electrical machines at one time, viz. with a poſitive and a negative one.

8. The conductor R, connected with the cuſhion, is that which is called the negative one.

9. The conductor G is called the poſitive one.

10. If the cylinder be excited, while the chain b hangs on the knob H of the conductor G, and a perſon applies his

knuckle, or any blunt body, near R, ſo that ſparks may paſs between it and the conductor, he is then ſaid to receive *negative ſparks* on his knuckle from the conductor R.

11. Again, if the chain b hangs on the knob H of the conductor R, and he applies his knuckle to G, within the ſtriking diſtance, he is then ſaid to receive *poſitive ſparks* on his knuckle from the conductor G.

12. Or if a perſon ſtands on the inſulated ſtool O, while it is connected with the conductor R, and ſparks paſs between him and any other perſon ſtanding on the ground, it is then ſaid that the perſon on the ground receives negative ſparks from the perſon on the ſtool.

13. And he, namely the perſon on the ground, will receive the reverſe, or poſitive ſparks, if the inſulated ſtool on which the perſon ſtands is connected with the conductor G; obſerving in each caſe, that the chain b muſt hang on the contrary

conductor to that with which the inſulated ſtool is connected.

14. In the following pages, ſpeaking of the conductors R and G, I have made uſe of the expreſſions Receiving and Giving, or words to that effect, inſtead of Negative and Poſitive. The propriety of this mode of ſpeaking is ſufficiently evident from what has already been ſaid in the preſent chapter.

15. Plate III. Fig. 1. repreſents the machine, with the apparatus, as in uſe for receiving electrical ſparks from the arm, without placing the perſon on the electrical ſtool.

16. But if electrical ſparks, inſtead of being received *from*, are to be given *to* the arm, then d, with the apparatus, is to be put to the conductor G, inſtead of R; by placing the ſtem of d in the hole at the top of G; and at the ſame time hanging the chain on the braſs knob H, at the ſide of R, inſtead of the ſide of G, as when ſparks were to be drawn from the arm. It is obvious, that

ſparks may either be received from or given to any other part by this apparatus, as it may be placed, by means of the joints, in any poſition, for that purpoſe.

17. Plate III. Fig. 2. repreſents the manner of drawing ſparks *from* and [illegible] giving ſparks *to* the hand, exactly as if it was electrified at the ſame time by two diſtinct electrical machines, namely, what is called a poſitive and negative machine.

Among the many proofs of the circuit of the electric matter, an elegant one is afforded by hanging the chain on the knob H of either of the conductors in this experiment; for the paſſage of the electricity is immediately diſturbed by the communication with the earth, and ſparks paſs only between the hand and the conductor which remains inſulated.

18. By this apparatus ſparks may at the ſame time be drawn *from* any part and given *to* any other part, without uſing the electrical ſtool; as, for example, ſuppoſe them to be taken from the knee and given

to the oppoſite ſhoulder. In this caſe the ball that is connected with the conductor R muſt be directed to the knee, and the other to the ſhoulder, which is eaſily done by means of the joints.

The chain‸ d muſt not be hung upon ‸b either conductor, when the electrical machine is intended to anſwer the purpoſes of two machines.

19. Plate III. Fig. 3, 4. is the ſame apparatus as in Fig. 1. but only repreſented in part, and with the conical points, inſtead of the ball; theſe are to be applied in the ſame manner as at Fig. 1. If the wooden conical point be uſed, then only the electrical aura or wind will be felt without any ſpark, and may be applied without the leaſt inconvenience even cloſe to the eye, as repreſented Fig. 3.

20. If the conical braſs point be uſed inſtead of the wooden point, then the electrical aura or wind will be felt, if the face, or any other part is at the diſtance of about five or ſix inches from it. If any

part be brought near the conical braſs point, ſharp pungent ſparks will be felt.

21. The conical points may alſo be applied and uſed inſtead of the balls in every experiment where the balls are mentioned, the ſcrew of the conical point being the ſame.

22. Plate III. Fig. 5. repreſents the hand of a perſon directing the ball by means of the pliable joints and tubes f f f, and glaſs handle K, to his leg, in order to give electrical ſparks to it; but if the tubes and joints had been connected with the other conductor, viz. R, then electrical ſparks would have been drawn from the leg, inſtead of being given to it.

23. Plate III. Fig. 6. repreſents a perſon directing the two balls by means of the pliable joints and tubes f f f, and the two glaſs handles k k, in order to draw electrical ſparks from one ſhoulder, and at the ſame time give them to the other, and that without ſtanding on the ſtool: theſe balls are readily directed to any other part, by

means of the aforeſaid glaſs handles and pliable joints.

The two ſets of tubes with flexible joints may be ſcrewed together to make a greater length, if it is required to electrify a perſon lying in a bed.

24. Plate IV. Fig. 1. ſhews the manner of connecting the electrical ſtool with either conductor by means of the tubes f f f with the flexible or pliable joints.

25. The arm repreſented in the Plate at Fig. 2. is ſuppoſed to be the arm of a perſon ſtanding on the electrical ſtool, and turning the cylinder at the ſame time, whereby he will receive more than his natural quantity of electricity, the ſtool being connected with the conductor G; and when the perſon applies his arm to the ball h within the ſtriking diſtance, he will then part with the overplus of electricity to it, that he has received more than his natural quantity.

26. If it is deſired, that weak ſparks ſhould be drawn from a perſon when ſtand-

ing on the ſtool, then the cord m ſhould not be connected with the wooden clamp l, repreſented as fixed to a chair, Fig. 2. but if it is deſired to have ſtronger ſparks, then the braſs ring of the cord m muſt be connected with the ſtem of the joint d, and the other end reſt on the floor; and if very ſtrong ſparks are required, then the end, inſtead of reſting on the floor, muſt be connected with metal, ſuch as the grate, &c. in the room: or otherwiſe the method mentioned § 12. Chap. III. may be uſed. There are other means of diminiſhing the quantity of electricity, as turning back the ſilk, &c. which will occur to the practitioner.

27. If the ſtool be connected with the conductor R, and the perſon applies his arm as before, he will then receive a quantity of electricity from the ball h, to ſupply what he was deprived of by being connected with that conductor.

28. In Plate IV. Fig. 3. is ſhewn another method of giving or receiving ſparks

to or *from* the leg or any other part, according to the conductor with which the ſtool is connected by means of the flexible joints, the perſon ſtanding on the ſtool, and turning the cylinder at the ſame time. This is done by means of the glaſs handle k, and one of the tubes f, with the piece g, into which the ſhort ſtem of k is put; one end of the cord m is ſcrewed to the end of the tube with the piece g, and the other part of the cord reſts on the floor. If the perſon is unable to hold the glaſs handles himſelf, the ſparks may be drawn *from* or given *to* him by another perſon ſtanding on the floor. Here alſo if ſtrong ſparks are deſired, the cord muſt be connected with metal, ſuch as the grate, &c. as before directed.

29. Plate V. Fig. 1. repreſents the manner of giving ſhocks through the elbow, or any other part. It is neceſſary, before you attempt to give the ſhock, to try the jar and tube whether they are not broke; to do which, take out the wire with the

ball and glaſs tube, and wipe it and the large jar clean and dry; then replace the glaſs tube, and put the wire with the ball into the hole in the cork, and hang on one ring of the chain b to it, and the other ring put on the knob on the board E. Then put the electrometer n, Plate II. into the hole on the top of the conductor, and ſlide the ball of n within a quarter of an inch to the knob H on the ſide of the conductor, and hang on the chains and wire, as repreſented in Plate V. Fig. 1. except this difference, that inſtead of the ends of the chain being faſtened to the arm, as repreſented, they muſt be made to touch one another on the table. Then if the large jar makes a diſcharge between the ball of the electrometer and conductor with a few turns of the handle, it ſhews that jar is whole. By removing the wire with the ball from the cork into the glaſs tube, it may be tried in the ſame manner. But if either jar or tube is very damp, or has the leaſt crack in them, there will be no diſcharge between the electrometer and conductor, if you turn ever ſo long.

The machine being now ready for giving the ſhock, if ſtrong ſhocks are deſired, the braſs wire with the ball muſt remain in the hole in the cork; but if very weak ſhocks, ſuch as the moſt delicate conſtitution can bear, then the braſs wire is to be removed from the cork, and put into the glaſs tube that is fitted into the ſaid cork. In both caſes the electrometer muſt be regulated according to the ſhock intended to be given, viz. if the ſtrongeſt ſhock of either jar or tube is wanted, the ball of the electrometer muſt be ſet at the furtheſt ſtriking diſtance from the knob H at the ſide of the conductor; and if the weakeſt ſhock, the ball muſt be very near the knob, but not touch it.

30. Plate V. Fig. 2. repreſents a perſon giving ſhocks along his leg, and in the ſame manner he may give the ſhock through any other part and in any direction, from the head to the foot, or from the foot to the

head. In this caſe, he muſt have an aſſiſtant turn the cylinder. An aſſiſtant will likewiſe be required in the operation of giving and receiving ſparks, as deſcribed § 25 of this chapter.

31. A very denſe ſtream of electricity may be drawn from either of the jars by hanging the chain from the ball of the jar to the table, and applying the knuckle to the outſide when charged, by turning the cylinder. If the chain, inſtead of touching the table, be hung by means of its two rings from the ball of one jar to the ball of the other, the ſtream will in like circumſtances be exceedingly more pungent. This ſtream may be conveyed to any part of the body, by means of the apparatus already deſcribed. In both theſe caſes a chain muſt hang from the knob H of that conductor, from which it is not intended the ſtream ſhall proceed.

CHAP. V.

PHILOSOPHICAL EXPERIMENTS AND OBSERVATIONS.

1. THE intention of this treatiſe not being to give a detail of the experiments relating to electricity, which are already well known, and amply deſcribed in other books; but rather to ſhew the convenience and advantage with which all experiments of this nature may be performed by the help of the machine which is now offered to the public patronage, this chapter will not be very diffuſe and extended. For the ſake of beginners, I ſhall curſorily enumerate the laws, or leading phænomena of electricity, and ſubjoin a few experiments, that, for their novelty, ſingularity, or the conſequences to which they point, ſeem to deſerve particular notice.

2. The eaſieſt method of collecting a conſiderable quantity of the electric mat-

ter, is by rubbing two bodies together, by which means a condenſation or rarefaction of the electric matter is produced at the ſurface of one or both of the bodies. But it is not a matter of indifference what kind of ſubſtance is uſed for this purpoſe. Some bodies will ſcarcely produce electric appearances by any rubbing together, and others poſſeſs the property of becoming electrified in a ſurprizing degree by that means. Now thoſe bodies which, by friction or otherwiſe, become electrified in ſuch a manner, that their electric ſtate cannot be taken off by touching a ſmall part of their ſurface, are called electrics. Glaſs, ſilk, roſin, ſulphur, dry vegetable fibres, and common air, are the chief ſpecimens of this claſs.

3. Bodies, which being by any means put into an electric ſtate, are capable of loſing that ſtate by the contact of another body at a ſmall part of their ſurface, are called Non-electrics, or, much more properly and frequently, Conductors. Me-

tals, charcoal, animal juices, and water, are almoſt the only conductors we know of.

Every ſubſtance in nature is either an electric or a conductor. Since an electric cannot be deprived of its electricity at any part, without actually touching or approaching very near that part, it is evident, that the electric matter is not conveyed or conducted either through the ſubſtance, or over the ſurface of electrics. And ſince the whole electricity of a conductor may be taken away by touching any part thereof, it is likewiſe evident, that the electric matter does paſs either through the ſubſtance, or over the ſurface of theſe bodies. The internal ſenſation of the ſhock, is one of the moſt obvious proofs that electricity paſſes through the ſubſtance of conductors.

4. The greateſt quantity of electricity is collected, when a perfect electric is rubbed by a perfect conductor. But there are circumſtances to be attended to, chiefly reſpecting the ſmoothneſs or roughneſs of the

contiguous ſurfaces, which, for the ſake of brevity, cannot be enumerated and deſcribed here.

5. The electricity which an electric acquires by friction with a conductor, is obtained from the conductor. So that if the conductor be inſulated, it will likewiſe become electrified, by loſing a part of its natural quantity, or by gaining a ſurplus, according as the electric body acquires a poſitive or negative ſtate. This has been in ſome meaſure explained in Chap. IV.

6. Bodies, in like and equal ſtates of electricity, repel each other; bodies in oppoſite ſtates attract each other; and bodies in the mean or natural ſtate are attracted by all electrified bodies whatever.

7. If a thin electric plate, as for example, glaſs, be electrified on one ſide, by friction or otherwiſe, and the other ſide be in contact with an uninſulated conductor, this laſt mentioned ſide will aſſume an electric ſtate, of the contrary nature to that induced upon the former. In theſe

circumſtances the glaſs is ſaid to be charged. The law of charging electrics, appears to be, that the ſum or whole quantity of electricity at both ſurfaces, is always either accurately or nearly the ſame. The following experiments, made with the patent electrical machine, ſet this important principle in an obvious point of view.

8. Experiment I. Take off the ends of the two conductors G and R, and the included jars will be viſible, the wires with the balls being ſtuck in the cork of each. Hang the chain b on the knob H of R, and turn the cylinder. The jar in G will not, in theſe circumſtances, become charged, excepting by means of a ſmall quantity of electricity, which will paſs from the ball of the jar into the air. But again, if the knuckle, or any other conductor, be applied near the ball of the jar in G, during the turning, ſparks will iſſue from it in abundance, ſtrong and frequent at firſt, but gradually leſs and leſs

ſo, and the jar will become charged. The inſulated jar being diſcharged, does not then appear to be in an electrical ſtate on either ſide, except a ſmall reſiduum, which is not carried off by the diſcharge.

The like experiment may be made, mutatis mutandis, by hanging the chain on the knob H of the conductor G.

9. Obſervation. Hence is deduced the conſequence, that neither ſide of an electrical jar can be charged either poſitively or negatively, unleſs the other ſide be ſo ſituated, as to be able to aſſume the contrary ſtate. And that the two ſtates are equal in intenſity, becauſe they deſtroy each other in the diſcharge.

The electricity which paſſes off into the air, may perhaps make this conſequence leſs evident to thoſe who reaſon and think ſuperficially. It ariſes from the power of the machine; and in many other common machines is ſcarcely perceptible. If the ſilk of the cuſhion be thrown back, much leſs electricity will be driven off.

10. Experiment II. Take the chain off from H, and hang it upon the wires of the jars in G and R, by means of its two rings. Turn the cylinder about ten times. The jars will be equally charged, as appears by ſeparately diſcharging them by means of the rod.

11. Experiment III. Repeat the laſt experiment with this variation, that, inſtead of ſeparately diſcharging the jars, apply the diſcharger from one conductor to the other. An exploſion will follow, and both jars will be at once, by that means diſcharged. The chain will at the ſame time be illuminated.

12. Obſervation. It is clear, from theſe two foregoing experiments, that two equal electrical jars may be charged without communication with the earth, by only altering the quantities of electricity at their ſurfaces. The machine exhauſts a quantity of the natural ſtock of electricity from the jar in R, and throws it upon the jar in G; while an equal part of the natural

ſtock in the inſide of the jar in G, removes by the chain to the inſide of the jar in R. Thus both jars become charged, and may be ſeparately diſcharged. But if a communication be made between the outſides, the equilibrium is reſtored; and at the ſame inſtant the ſurplus, which had removed from the inſide of one jar to that of the other, flies viſibly along the chain, to its original place. The paſſage of the electricity between the two outſides, may likewiſe be rendered viſible, if the luminous inſulated diſcharging rod t be made uſe of.

13. Experiment IV. The two foregoing experiments ſucceed in the ſame manner, when another chain is hung from one of the knobs H to the earth.

14. Experiment V. In the laſt experiment, if the chain, inſtead of communicating with the earth, be hung from the knob H to the wire of the ſame jar, the other jar only will be charged.

15. Obſervation. The charging of the jar in Experiment IV. whoſe outſide communicates with the earth, is a conſequence of the alteration which the ſtate of the inſides undergoes during the charging of the other jar. The uncharged jar, in Experiment V. remains in its natural ſtate, becauſe its two ſides communicate by means of the chain. This jar may be regarded only as an inſulated conductor, which conveys the electricity from the inſide of the other jar to its outſide; and the experiment affords the ſame conſequence, with regard to a ſingle jar, as Experiments III. IV. do with reſpect to two.

Experiment VI. Hang the chain from the knob H of one of the conductors, and fit the electrometer to the other. Hang the other chain from the electrometer to the wire of the jar in the conductor, to which the electrometer is fitted. Set the ball of the electrometer within the ſtriking diſtance from H, and turn the cylinder. The electricity will be diſcharged viſibly along the chain: but if the ball of the electrometer be placed cloſe to H, the jar will not become charged, and no ſpark will appear.

Obſervation. In this experiment, the jar in the firſt ſituation becomes charged, by the inſide aſſuming, by means of the air, a ſtate contrary to that ſuperinduced on its outſide; and the diſcharge ſhews the paſſage of the electricity in reſtoring the equilibrium. In the latter ſituation it is proved, that the inſide, by its communication with the outſide, not being allowed to aſſume the contrary ſtate, the jar cannot be charged.

It is preſumed that the following uncommon experiments will be acceptable to the curious.

16. Experiment VII.* To make a number of ſmall holes in a glaſs tube. Stop one end of the tube with a cork, and

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* This experiment was communicated by the Rev. Mr. Morgan of Norwich.

pour a quantity of ſallad oil into it. Stop the other end with a cork, through which is previouſly inſerted a wire, whoſe lower end is pointed, and bent at right angles to its length, and its upper end turned into a hook. Let the inner end of the wire be below the ſurface of the oil; and hang the whole apparatus upon the knob H of one of the conductors. Then if the conductor be electrified by turning the machine, and the finger, or any other uninſulated conductor, be brought near the lower end of the wire in the tube, a ſpark will paſs to it through the oil and glaſs, making a ſmall hole.

This experiment affords ſome beautiful appearances when tried in the dark; and on many accounts appears to be very fruitful in conſequences.

17. Experiment VIII. * To make the

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* This experiment occurred to me, on trying the experiments mentioned in Nicholſon's Introduction to Natural Philoſophy, vol. II. page 388. All the other experiments, except Experiment VII. are original.

ſoft Dutch ſealing-wax aſſume the appearance of wool.

Take a piece of ſealing-wax, about an inch long, or leſs, and ſtick one end of it on the copper ball. Screw the ball to the joint; place the ſtem in the hole of one of the conductors, and hang the chain on the knob H of the other. In this ſituation warm the wax gently with a candle, till it is almoſt ready to drop. Remove the candle, and immediately excite the cylinder; at the ſame time holding the other copper ball, ſcrewed to the end of the tube f, at about twelve inches diſtance from the wax. The electricity will immediately throw the wax upon the other ball in ſeveral very fine threads, which being wiped off with the finger, are ſcarcely diſtinguiſhable from red wool.

18. Experiment IX. To cauſe the mercury in a thermometer to riſe by means of electricity.

Take a mercurial thermometer, with a ſmall bulb. The wooden ſcale muſt be ſo ſhort, as not to reach down to the bulb by about three inches, which ſpace will therefore be entirely clear. Prepare the machine as repreſented Plate III. Fig. 2. excepting that, inſtead of the copper balls, there muſt be ſubſtituted two balls of ſoft wood, about two inches in diameter. Suſpend the thermometer ſo, that its bulb may be immediately between the balls, which muſt not be more than half an inch aſunder. Excite the cylinder, and a ſtream of electric matter will paſs between the balls. The mercury will inſtantly begin, and continue to riſe, till it exceeds its former height very conſiderably. I have raiſed it from 67 to 99 degrees of Fahrenheit's ſcale. The ſpirit thermometer is affected in a ſimilar manner by the ſame treatment.

19. Experiment X. The ſpark drawn from a conductor, in a negative ſtate, is much more pungent than the ſpark drawn from a ſimilar and equal conductor, in an equal poſitive ſtate.

The proof of this by the patent machine, is too obvious to need any particular inſtructions.

The different figure of the ſpark appears to be the proximate cauſe of the phænomenon. For the ſpark proceeding from a poſitive conductor, is emitted from a ſingle point of the ſurface; but when it has proceeded about one third of its length, it becomes divided into many radiations, ſpringing from a kind of luminous ſpeck. It does not therefore enter the hand of the obſerver at one, but at many points of the ſurface, and conſequently its effects are divided and weakened. But the contrary happens when the conductor is in a negative ſtate, the ends of the ſpark being as it were reverſed. The paſſage of the electricity is made through a ſingle point, or ſmall part of the ſkin of the obſerver, and the irritation becomes much greater.

Experiment XI. To cauſe the charge of three ſquare inches and a half of coated glaſs, to fly through the air in a denſe ſpark of five or ſix inches in length.

Take off the ends of the conductors G and R. Inſert the knobbed wires in the ſmall coated jars or tubes, and hang the chain b from one wire to the other. Turn the cylinder, and, reſting the inſulated diſcharger upon the poſitive conductor, bring the other ball near the negative conductor. If the machine be dry, and in a good ſtate, the diſcharge will fly in denſe ſparks of more than ſix inches in length. But if, on the contrary, the one ball of the diſcharger be reſted on the negative conductor, and the other ball brought towards the poſitive conductor, this laſt ball will act as a point, drawing off the electricity with a ruſtling noiſe, at the diſtance of twelve inches or leſs; and will not produce a ſpark till the diſtance is very ſmall.

CHAP. VI.

MEDICAL OBSERVATIONS.

1. THERE can be no doubt, ſince the electric matter is found in all bodies, but that it is an univerſal and principal agent in the ſyſtem of the world. Much remains to reward the aſſiduity of future diſcoverers. Electricity is yet in its infancy; but like the other branches of philoſophy, its infancy has been embarraſſed by a number of theories, contrived by men who prefer the effuſions of fancy to the ſlow though ſure method of experiment and obſervation. General inferences drawn from experiments, which were either few, inaccurate, or falſe, have in many inſtances diſgraced the ſciences. The influence of electricity on the animal frame has never been diſputed; but the

ſucceſs of its application to the cure of diſorders has been exceedingly magnified by ſome writers, and as much ſlighted by others. The common ſource of both theſe oppoſite opinions may be attributed to the ſuperficial obſervations of thoſe who held them. But it is now eſtabliſhed from a multitude of facts, that electricity is almoſt a ſpecific in ſome diſorders, and deſerves to be held in the higheſt eſtimation for its efficacy in many others. It is not intended in this ſhort treatiſe to give any circumſtantial account of the caſes upon which the following part of this chapter is grounded; but the reader may depend upon it, that it contains not a ſingle aſſertion which has not been confirmed either by the author's own experience, or the teſtimony of a numerous acquaintance of ingenious and worthy gentlemen, who are ready to promote any undertaking which is intended to advance the public good.

2. The early method of applying electricity conſiſted in giving large ſhocks from jars of very conſiderable magnitude. This practice is at preſent diſcontinued, and an opinion ſeems to prevail, that the gentler methods of ſimple electrization, ſuch as ſtanding on the ſtool, drawing the electric aura or wind by wooden or metallic points, and drawing the ſparks as circumſtances may require, are ſufficient in all thoſe caſes in which electricity can be uſed with advantage. It is difficult for one who thinks he has made a diſcovery to avoid running into extremes; and perhaps upon reflection, we ſhall not find reaſon entirely to exculpate thoſe who ſo ſtrenuouſly recommend thoſe very gentle methods. It is certain, that the adminiſtering of ſhocks has done ſervice in caſes in which ſimple electrization has not been found effectual; and therefore it would be injudicious to attempt to eſtabliſh any general rule for excluding them. And on the contrary it muſt be granted, not to mention the diſ-

agreeable ſenſation to the patient, that very ſtrong ſhocks are ſometimes injurious, and if they do not produce an immediate good effect are often found to be of very little ſervice when continued. The medium ſeems preferable, that is to ſay, to begin with ſimple electrization or ſtanding on the ſtool, and to proceed gradually as may be thought neceſſary to draw the electric matter by metallic or wooden points; to draw the ſparks by rubbing a metallic ball quickly backwards and forwards over a part of the body covered with a woollen cloth; to draw ſparks of different ſizes, as directed § 12. Chap. III. or § 28. Chap. IV. to draw the denſe ſtream, as directed § 33. Chap. IV. or to give ſhocks, which may be either general or confined to a particular part. A little experience will enable the operator to judge the proper degree of electricity; and the patent machine is peculiarly applicable to every known method of applying it.

3. The opinions of the faculty are divided concerning the mode of action, which electricity exerts on the human frame. By ſome it is thought to relax univerſally, and by others to be ſtimulant and bracing. Both opinions ſeem to agree with the facts. Electricity, applied in the gentleſt manner, appears to be ſedative and relaxing; and in the ſtronger methods it may naturally be ſuppoſed to ſtimulate. But it is an advantage, that we are not under the neceſſity of waiting till a theory is eſtabliſhed before we can receive benefit from the powerful, though ſafe, application of electricity.

4. The very many cures performed by electricity in the hands even of perſons entirely unſkilled in medicine, and its never having produced any ill effects when applied with moderate degrees of force, give it an advantage which perhaps no other remedy is entitled to claim. It may be laid down as an eſtabliſhed fact, that electricity judiciouſly applied has never done

hurt. A healthy fibre is never injured by it. It may conſequently be conveyed without any difficulty or apprehenſion to the ſeat of any local diſorder, as it may be paſſed without any diminution of its virtue through the intervening ſound parts.

5. Simple electrization, or ſtanding on the ſtool, is affirmed to increaſe the circulation of the blood, and promotes glandular ſecretion.

6. The various applications of electricity are particularly ſerviceable in obſtructions. In many diſorders, whoſe remote cauſes are of this nature, its action and effects are beyond expectation. The ſuppreſſion of the catamenia and all its conſequent evils are removed to almoſt an abſolute certainty, by paſſing the electric matter through the region of the pelvis. Very many inſtances of patients relieved from the moſt hopeleſs ſituation conſpire to recommend this remedy as ſpecific in ſuch caſes; and the advantages mankind may reap from it are [redacted] ſo much the more

valuable, as the materia medica furniſhes us with few medicines at all adequate to the purpoſe. The method of adminiſtering electricity for theſe diſorders is to place the patient between the two balls h h, Fig. II. Plate III. placed on oppoſite ſides of the waiſt, and accordingly as the ſenſation is more or leſs diſagreeable, the balls muſt be removed nearer to or farther from the body. In ſome inſtances, the points may be ſubſtituted inſtead of the balls. Care muſt be taken to be aſſured, that the patient is not pregnant, and the electricity ſhould rather be too weak than too ſtrong, for fear of producing an immoderate flow.

7. Nervous diſorders in general give way to gentle electrization, but are ſometimes aggravated by the application of too great a force. Nervous head-aches are often mitigated and entirely relieved by the electric wind from a metallic or wooden point, applied at a diſtance oppoſite the temples and ſucceſſively round the head. The effects of too much irritation are ſo exceed-

ingly diſagreeable, that great attention muſt be had to make trial firſt of the mildeſt methods.

8. In recent bruiſes, burns, ſcalds, or any other local pain of no long ſtanding, numberleſs inſtances eſtabliſh the immediate efficacy of electricity. The electric wind or ſparks may be uſed in theſe caſes.

9. The natural ſecretions are promoted by electricity, and thoſe which are adventitious or unnatural are retarded and often ſuppreſſed. The latter effect ſeems to be a conſequence of the former; for moſt unnatural diſcharges are cauſed by the obſtruction of ſome natural ſecretion or circulation, which ought to have been performed. Thus the proximate cauſe of the purulent diſcharges of ulcers, &c. is either the ſtoppage of the circulation or the perſpiration of the part, whoſe veſſels are inflamed or obſtructed; and if electricity be poſſeſſed of power to promote a proper circulation through the finer paſſages, the vicious diſcharge muſt ceaſe of courſe. It

ſeems to be a good method in ſuperficial complaints to adminiſter the aura, or ſparks; but in diſorders which principally affect the interior part of the body, ſhocks are to be preferred.

10. Blood-ſhot, and other inflammations of the eyes, are almoſt always cured by the electric wind. The fiſtula lacrymalis has been cured, in many inſtances, by the ſame treatment. And there are not a few remarkable caſes, in which blindneſs, whether ariſing from an opacity of the cornea or the inſenſibility of the retina, has been removed by electricity, applied either in the form of wind or ſparks to the eye itſelf, or ſhocks paſſed near the eye. But it muſt be confeſſed, that it has failed in many other inſtances of this laſt kind.

11. The tooth-ache, ariſing from cold, is generally cured by drawing the ſparks from the outſide of the face oppoſite the tooth. A ſtrong ſhock properly directed through a tooth beginning to decay, fre-

quently takes away the pain by deſtroying the ſenſibility of the end of the nerve.

12. The ſore throat is very often cured by drawing ſparks; and the ſame method is frequently ſucceſsful in diſpelling glandular tumors, even of the greateſt magnitude. Generally ſpeaking, all ſwellings which do not contain matter are diſperſed by electricity; and thoſe which do are benefited by it. Cutaneous eruptions are often cured by the electric wind.

13. Deafneſs from cold, from too much wax, or proceeding from a fever, ſeldom fails of being removed by the electric aura, by drawing ſparks, or by gentle ſhocks from one ear to the other.

14. Sprains, cramps, contractions, among which the locked jaw ſtands confirmed by many ſucceſsful caſes, and few to the contrary, rheumatic pains, whether local or otherwiſe, are all peculiarly within the province of the electrical operator, as they have been conſtantly removed with ſcarcely any exception. The method is to

uſe repeated ſmall ſhocks through the part affected, and increaſe the force till ſucceſs attends; but in theſe, as in all other caſes, the feeling of the patient muſt be conſulted; for ſhocks which are ſo ſtrong as to be very diſagreeable, are not ſo effectual as when ſmaller.

15. The ſciatica, the proper gout, and the palſy have been often cured by electricity, applied according to the various degrees. The firſt of theſe diſorders is much more capable of relief from electrical treatment than the other two. It is thought by ſome, that there is danger of repelling the morbid matter of the gout from the extremities to the nobler parts, but this opinion does not ſeem to have any ſolid foundation. In recent palſies, much good has been done even on patients far advanced in years; but palſies of long ſtanding, though relieved at firſt, are ſeldom effectually cured. The moſt judicious method appears to be that of firſt drawing ſparks from the diſeaſed part, and

afterwards to give ſhocks confined to the part, rather ſtrong at firſt but weaker as the ſenſe becomes more acute.

16. Conſiderable cures have been performed by electricity in epileptic and hyſterical caſes. A few ſhocks adminiſtered during the fit from arm to arm through the cheſt almoſt infallibly removes theſe diſorders; and a daily continuation of the remedy for ſome days after has prevented the return in many caſes in which the diſorder had long been habitual. When the period is known, or the approach of a fit can be predicted, a few gentle ſhocks may perhaps avert the evil.

17. Agues are cured by adminiſtering ſhocks through the cheſt and ſides, or croſs-ways from each hand to the oppoſite foot, juſt before the fit is expected. This diſorder is commonly cured by a very few times electrifying.

18. The medical effects of electricity ſeem to proceed from the mere paſſage of the electric matter, and little if at all from

its direction; for experience has not pointed out any ſenſible difference between the poſitive and negative electrization; excepting only the difference pointed out Exper. X. Chap. V. which the careful operator will ſometimes find it neceſſary to attend to.

19. The very ſudden cures which are daily performed by electricity, and the exaggeration which is made in relating facts by thoſe who are fond of the marvellous, have led many patients into an expectation, that their diſorders will vaniſh as it were by enchantment, when they are electrified. It is not enough for theſe miſtaken people to be informed, that electricity, both for its univerſality and efficacy, deſerves to ſtand firſt in the liſt of remedies; but they require it to work miracles. For this reaſon, and to prevent the diſcouragement which the diſappointment of their unreaſonable expectations may cauſe, it is neceſſary to obſerve, that inſtantaneous relief muſt not always be expected; and that

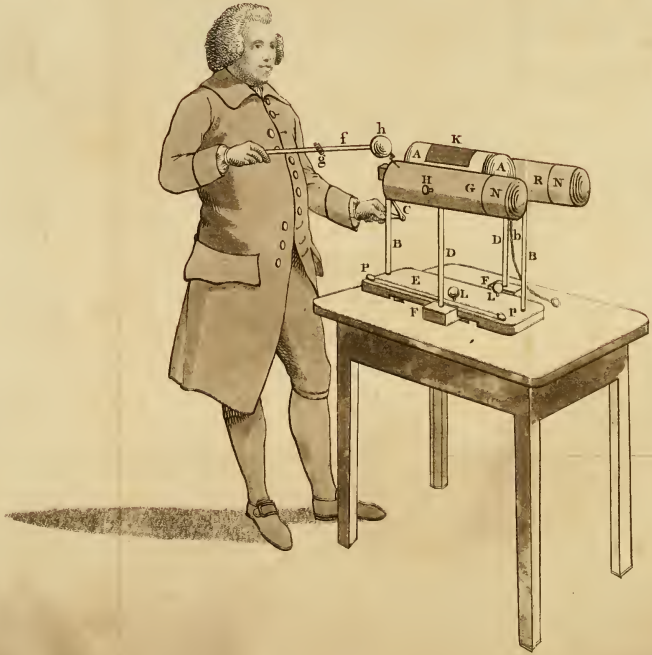
ſeveral diſorders, which were not ſenſibly affected by a month or more electrization, have in time been cured by perſevering in the uſe of the remedy. It is probable, that many of the caſes in which electricity has failed would have been crowned with ſucceſs, if the opinion of its inefficacy had not been too haſtily adopted.

20. The reader, who may be inclined to think the aſſertions contained in this chapter ſtand in need of the ſupport of the facts, is referred to the Philoſophical Tranſactions; Becket's Eſſay on Electricity; Cavallo's Eſſay on the Theory and Practice of Medical Electricity; Birch's Conſiderations on the Efficacy of Electricity in removing female Obſtructions; New Thoughts on Medical Electricity, or an Attempt to diſcover the real Uſes of Electricity in Medicine; Symes's Fire analyſed; Lovett's ſubtil Medium proved; and Weſley's Deſideratum, in all which he will find a variety of well atteſted caſes.

⁂ The number of applications which have been made to Mr. Nairne, by patients deſirous of receiving the benefit of medical electricity, renders it neceſſary for him reſpectfully to inform the public, that his other avocations make it impoſſible for him to attend to any applications of that nature.

When leiſure permits, Mr. N. propoſes to publiſh ſome papers formerly communicated by him to the Royal Society, and which have been ſince printed in the Philoſophical Tranſactions. The references are as follow; Experiments on metals, animals, and vegetables, Vol. 64. On the advantage of elevated pointed conductors, Vol. 68. On the effect of electricity in ſhortning wire, Vol. 70. An account of the ſame effect produced by lightning, Vol. 72.

PLATE . 1.



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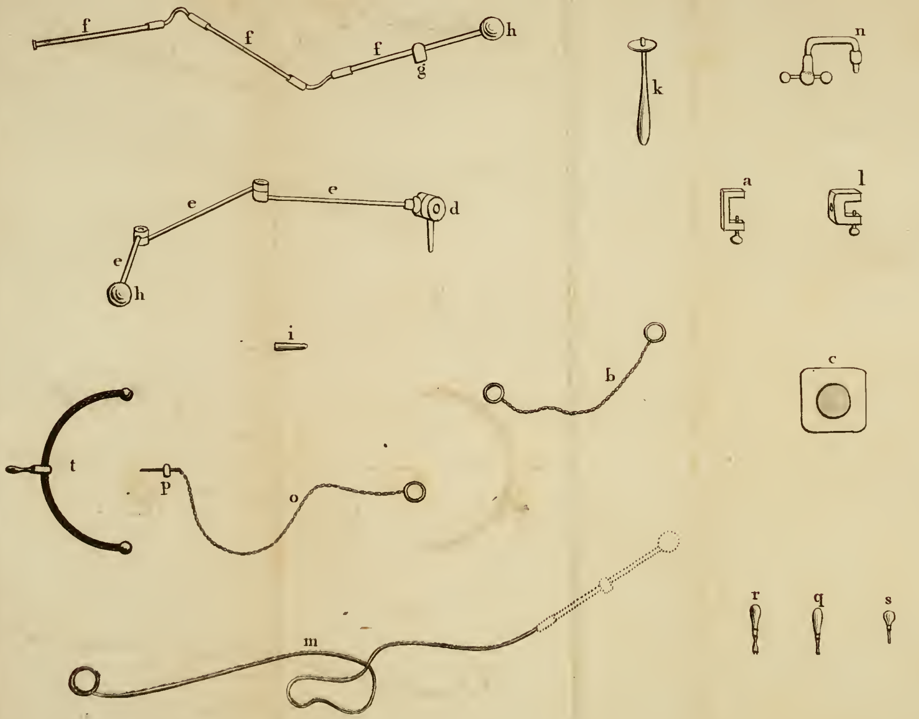
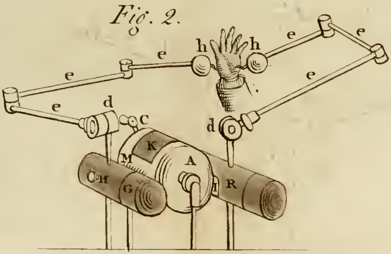


Fig. 2.



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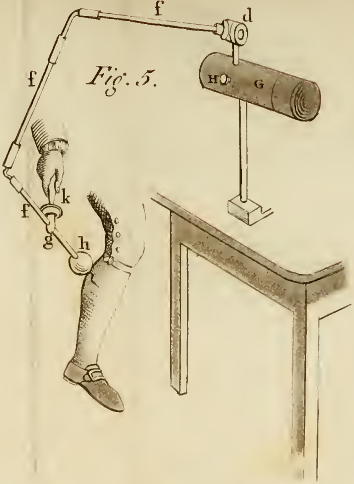

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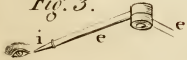
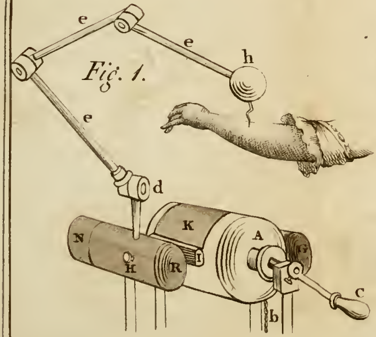


Fig. 1.



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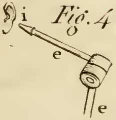

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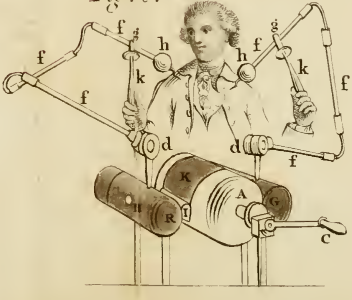

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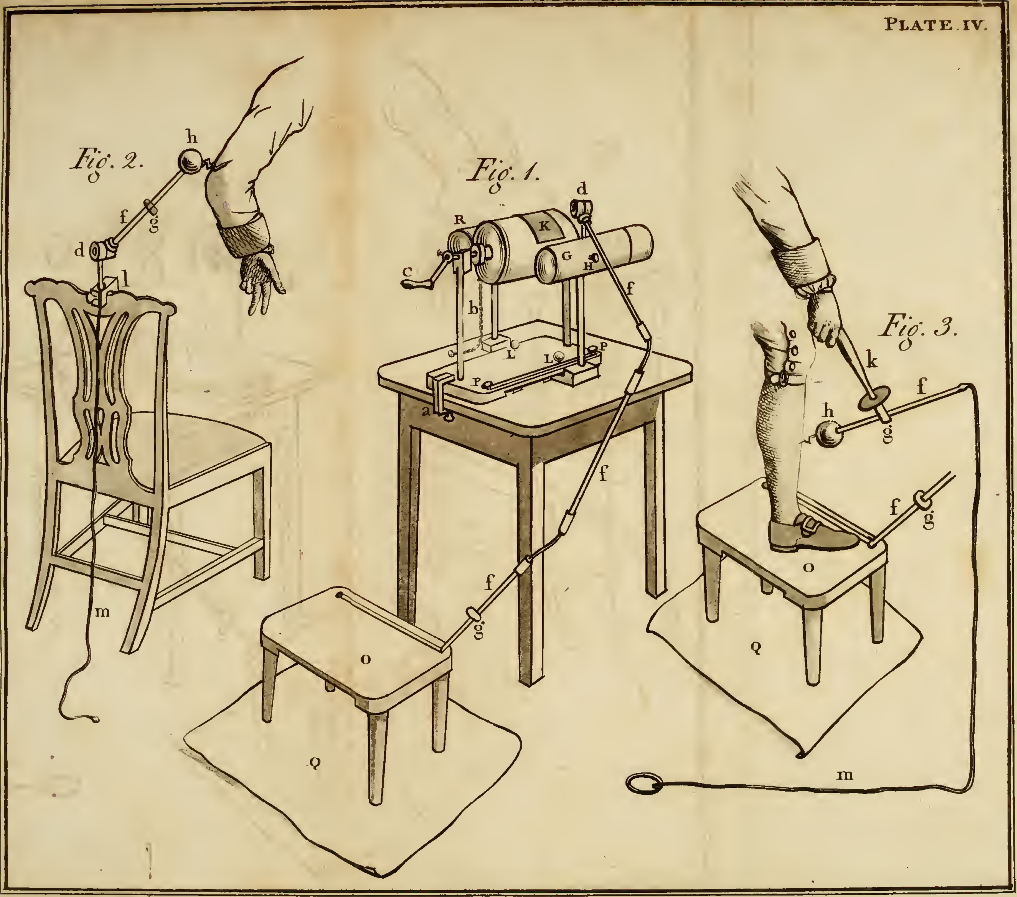


PLATE. V.

Fig. 1.

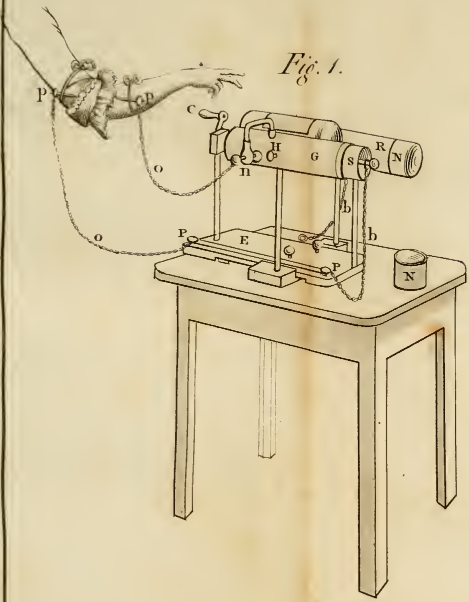
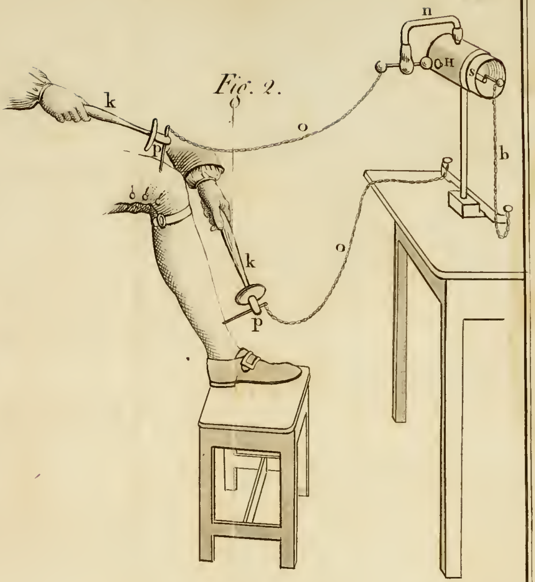


Fig. 2.



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Ditto ditto, two Feet long, with one magnifying Power, on a three legged Braſs Stand					12	12	0
Ditto ditto, 18 Inches long					8	8	0
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